The Center of Excellence for Communication Systems Technology Research

CECSTR CURRENT RESEARCH PROJECT ACTVITIES

Research Topic: Broadband Dynamic Spectrum Access: Analysis, Testing, Measurement and Optimization of Energy Detectors Using Artificial Intelligence and Machine Learning Techniques

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Synopsis of the Research Project

The growth of broadband wireless communications cannot be overemphasized in this 21st century. Despite the increasing efficiency of technologies, the demand for bandwidth exceeds the availability of spectrum for new broadband communication services and networks. These growing trends include work from home and virtual learning pertaining to the COVID-19 pandemic and increased demand for low-power wide-area (LPWA) networks in the IoT applications. According to Cisco Inc., North American wireless network carried approximately 17 petabytes per month (data equivalent to 1,700 Libraries of Congress) in 2009 and it was projected to be about 740 petabytes, greater than 40-fold increase by 2014 [1]. The key to the emerging paradigm of opportunistic broadband dynamic spectrum access (DSA) is the cognitive radios, which can dynamically sense the environment and rapidly tune their transmission parameters to best utilize the premium spectrum real estate. Therefore, the first "cognitive" requirement preceding any form of broadband dynamic spectrum management is the capability of efficient (quick) and robust spectral sensing technique for identification of the vacant/underutilized spectrum bandwidth. Among the various known spectrum-sensing techniques, blind sensing based on energy detection is perhaps the simplest and most versatile. However, the detection performance of energy detectors is severely limited by harsh propagation environments and becomes unreliable at low signal-to-noise ratio (SNR). This issue is further complicated by the noise uncertainty and shadowing problem. The objective of this research is to alleviate these problems by providing efficient spectrum sensing schemes while meeting the low cost solution constraint based on the energy detection.

Research Expectations

We intend to explore the areas of spectrum for new broadband communication services and networks for testing and measurement such as:

- Developing efficient artificial intelligence and machine learning testing and measurement frameworks for analysis of wideband spectrum sensing using energy detectors;
- Development of frequency domain testing and measurement based on energy detector (modified periodogram) using artificial intelligence and machine learning; and
- Analyzing and testing ultra-wideband (UWB) radar sensor networks based on energy detection using artificial intelligence and machine learning.

Some of these challenges include interoperability, spectral crowding and global seamless connectivity. These challenges become more of a concern with the tremendous growth in the wireless industry.

Reference

[1] Cisco Sys, "Cisco Visual networking index global mobile data forecast 2009-2014 (2010)." Available at http://www.cisco.com.